

CIMARRON RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Cimarron River
Water Quality Impairment: Chloride

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Upper Cimarron–Liberal

County: Meade

HUC 8: 11040006

HUC 11s (HUC 14s): 060 (020, 030, & 040)

Drainage Area: 62.3 square miles

Main Stem Segment: 1; starting at state line and traveling upstream toward Hayne. **(Figure 1)**

Designated Uses: Special Aquatic Life Support; Primary Contact Recreation; Secondary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use.

1998 303(d) Listing: Table 3 - Predominantly Natural Conditions

Impaired Use: Domestic Water Supply

Water Quality Standard: 250 mg/L for Domestic Water Supply (KAR 28-16-28e(c)(3)(A))
352 mg/l for Aquatic Life Support (K.A.R. 28-16-28e(c)(2)(F)(i))

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(e). Background concentrations shall be established using the methods outlined in the “Kansas implementation procedures: surface water,” dated June 1, 1999... (KAR 28-16-28e(b)(9)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303(d): Not Supporting Domestic Water Supply

Monitoring Site: Station 222 near Forgan, OK

Period of Record Used: 1986 to 2000

Cimarron River TMDL Reference Map

Upper Cimarron - Liberal Subbasin

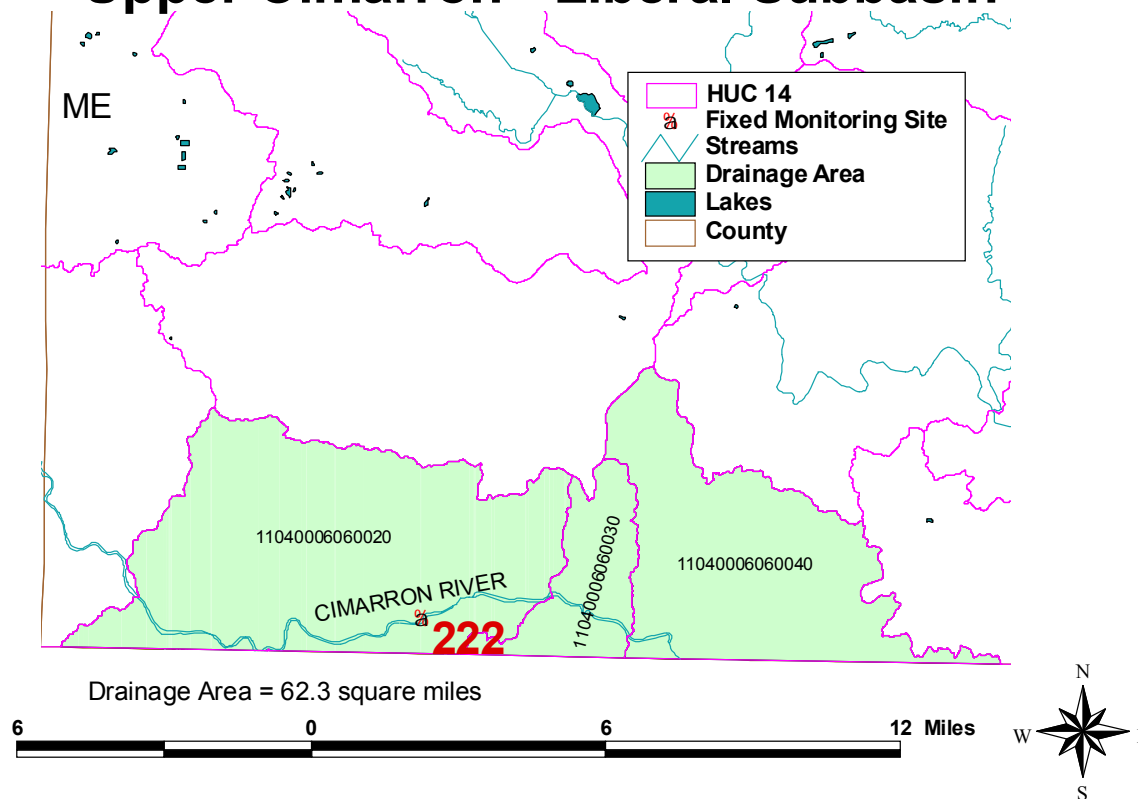


Figure 1

Flow Record: Cimarron River flow conditions were estimated by using actual flow data for the Crooked Creek near Englewood (USGS Station 07157500; 1975 - 1999)

Long Term Flow Conditions: Median Flow = 10 cfs, 7Q10 = 1 cfs at Crooked Creek near Englewood

Current Conditions: Chloride concentrations have ranged from 794 mg/l to 1210 mg/l over the period of record. Using flow conditions at Englewood as a guide the average baseflow concentration was determined to be 1,010 mg/L. This would represent a natural background concentration for the Cimarron River. Excursions were seen in all three seasons. One hundred percent of samples from water quality site 222 were over the criterion of 250 mg/l.

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 222 over 2005 - 2009:

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Drinking Water Use. This TMDL will, however, be phased. The current standard of 250 mg/L of chloride was used to establish the TMDL however, the Cimarron river is subject to mineral intrusion from upwelling groundwater from the Permian Formation. As such, the segment has highly elevated chloride levels from this natural source. This natural background of chloride, estimated to be considerably above 250 mg/L, makes achievement of the Standard impossible.

Kansas Implementation Procedures for Surface Water allow for a numerical criterion based on natural background to be established using the mean concentration of in stream measurements gathered when stream flow was less than the median flow on the creek. A minimum of five data points is needed to determine the background concentration. The specific stream criteria to supplant the general standard will be developed concurrent with Phase One of this TMDL following the appropriate administrative and technical Water Quality Standards processes. Meanwhile, a Phase One endpoint has been developed based on currently available information and is 1,010 mg/L from data collected over 1990-1999 at flows equal to or less than median. The Phase Two TMDL will be based on the future standard.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of elevated chloride levels. Achievement of the endpoints indicate loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

3. SOURCE INVENTORY AND ASSESSMENT

The Cimarron River gains flow from ground-water discharge in Seward County and the southwest corner of Meade County. The ground-water discharge is fresh in central Seward County but becomes slightly saline in southeast Seward County. The salinity of the ground-water discharge increases substantially in southwest Meade County. The source of the salinity is natural intrusion of saltwater from the Permian bedrock into the overlying High Plains aquifer, then into the alluvial aquifer, and finally into the river. The saltwater in the Permian bedrock derives from dissolution of evaporite minerals in the Permian bedrock. The main evaporite minerals are halite or rock salt (NaCl) anhydrite, (CaSO₄), and gypsum (CaSO₄ · 2H₂O). The main zone of the High Plains and alluvial aquifers that are affected by the saline water are along the river valley. Upward ground-water flow is concentrated in the valley due to the lower hydraulic head of water at the lower elevation of the river channel than in the surrounding uplands.

Gutentag et al. (1981) measured flow and sampled the Cimarron River from northwest Seward County to southwest Meade County on November 14, 1974. Measurements during that time of year avoided the effects of evapotranspiration by phreatophytes along the river. The chloride concentration remained at 21 ±2 mg/L from northwest to central Seward County. The chloride concentration rose

steadily in the river water in southeastern Seward County, reaching 186 mg/L at the Seward-Meade county line. The chloride content then increased substantially in the southwest corner of Meade County to 620 mg/L at the KDHE sampling station No. 222 near Forgan, Oklahoma. The chloride content was 650 mg/L at a location about 2 miles east of the station 222 location. The chloride values in the KDHE database for station 222 on 10/22/74 and 12/3/74 were 640 mg/L and 590 mg/L, respectively.

The Permian bedrock underlying the High Plains aquifer contains saltwater with a chloride content up to at least 20,000 mg/L along the Cimarron River corridor in southeast Seward and southwest Meade counties. The Permian water also contains a high sulfate content although it is probably limited by the solubility of gypsum or anhydrite. The chemistry of the Cimarron River water fits the mixing of saltwater in Permian bedrock in southwest Meade County with freshwater in the High Plains aquifer.

The chloride concentration of Cimarron River water at the KDHE station No. 222 has been increasing substantially with time. The chloride concentration of lower flows in the river ranged between 450 and 700 mg/L in the late 1960's and rose to between 900 and 1,200 mg/L by the late 1990's. The increase in chloride with time probably reflects a decrease in freshwater discharge from the High Plains aquifer to the river in central Seward County as a result of ground-water level declines in the aquifer. The natural saline water discharge is still continuing but there is less freshwater from upstream to dilute the saline water.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Additional sampling and assessment will be necessary to ascertain the amount of natural background chloride loading within the watershed.

Point Sources: A Wasteload Allocation of zero will be established by this TMDL because of the lack of point sources along the segment. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Non-Point Sources: Elevated chloride concentrations appear to be a natural feature of the river. Nonetheless, no external sources or loads should discharge into the river, thereby increasing the chloride concentration. Therefore, the Load Allocation of chloride contributing substances will be set to reduce the long term average chloride on the river below 1,010 mg/L at baseflow.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of loading and the chloride endpoint. The current margin of safety is implicit because of the conservative assumption that zero allocations are assigned to anthropogenic sources, ie, the current loading is natural. However, in the future, the margin of safety will be used to reduce any proposed future wasteload allocations by 10%.

State Water Plan Implementation Priority: Because it presently appears that the chloride load is natural in source, this TMDL will be a Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Upper Cimarron–Liberal Subbasin (HUC 8: 11040006) and is a Category II watershed (watershed in need of protection).

Priority HUC 11s and Stream Segments: Pending additional monitoring and assessment, no priority subwatersheds or stream segments should be identified until after 2005.

5. IMPLEMENTATION

Desired Implementation Activities

1. Establish appropriate background concentrations and confirm designated uses

Implementation Programs Guidance

Water Quality Standards and Assessment - KDHE

- a. Confirm designated uses of domestic water supply and livestock watering on stream reaches
- b. Establish background levels of chloride for Cimarron River

Timeframe for Implementation: Development of a background level- based water quality standard should be accomplished with the 2002 water quality standards.

Targeted Participants: Primary participants for implementation will be KDHE .

Milestone for 2005: The year 2005 marks the mid-point of the ten year implementation window for the watershed. At that point in time, additional monitoring data from Station 222 and other sites of significance on Cimarron River will be re-examined to confirm the impaired status of the river and the suggested background concentration. In light of this additional data, assessment, allocation and implementation activities will ensue.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

Reasonable Assurances

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

2. K.S.A. 82a-706. Empowers the chief engineer of the Division of Water Resources, KDA, to enforce and administer the laws of this state pertaining to the beneficial use of water and shall control, conserve, regulate, allot and aid in the distribution of the water resources of the state for the benefits and beneficial uses of all of its inhabitants in accordance with the rights of priority of appropriation.

3. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

4. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

5. The *Kansas Water Plan* and the Cimarron Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund, annually generates \$16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This TMDL is a Low Priority consideration and should not receive funding.

Effectiveness: Minimal control can be exerted on natural contributions to loading.

6. MONITORING

KDHE will continue to collect bimonthly samples at Station 222, including chloride samples over each of the three defined seasons. Based on that sampling, the status of 303(d) listing will be evaluated in 2006 including application of a numeric criterion based on background concentrations. Should the impaired status remain, the desired endpoints under this TMDL will be refined and direct more intensive sampling will need to be conducted under specified seasonal flow conditions over the period 2005-2009.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Cimarron Basin were held March 8 and April 25 in Meade. An active Internet Web site was established at <http://www.kdhe.state.ks.us/tmdl/> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Cimarron Basin.

Public Hearing: A Public Hearing on the TMDLs of the Cimarron Basin was held in Meade on May 30, 2000.

Basin Advisory Committee: The Cimarron Basin Advisory Committee met to discuss the TMDLs in the basin on October 6, 1999; January 12, 2000; March 8, 2000.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Agriculture: February 28, 2000

Milestone Evaluation: In 2005, evaluation will be made as to the degree of impairment which has occurred within the watershed and current condition of the listed stream segments. Subsequent decisions will be made regarding implementation approach and follow up on additional implementation in subwatersheds.

Consideration for 303(d) Delisting: This watershed will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2006 303(d) list. Should modifications be made to the applicable criterion during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2002 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Year 2005.

Reference

Gutentag, E.D., Lobmeyer, D.H., and Slagle, S.E., 1981, Geohydrology of southwestern Kansas: Kansas Geological Survey, Irrigation Series 7, 73 p.

Approved September 11, 2000.